Argonne NATIONAL LABORATORY

Advanced Videoconferencing for Computational Fluid Dynamics (CFD) Training

Training Context	
Subject	• Computational Fluid Dynamics (CFD) Training
Participants	• Argonne National Laboratory - TRACC (Illinois) • Turner-Fairbank Highway Research Center (Virginia) • University of Nebraska - Omaha (Nebraska) • Illinois Institute of Technology (Illinois) • University of Illinois at Urbana-Champaign (Illinois) • University of Iowa (Iowa)
Training Method	• Traditional lecture, hands-on tutorial problems, and Q&A sessions
Length of Class	• Three days
Technical Context	
Conference Type	• Multipoint
Technology Used	• H.323-based videoconferencing • Adobe Acrobat Connect
Additional Equipment	• Polycom HDX 8004 HD codecs • LifeSize HD Room System
Contact	
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Background

Argonne National Laboratory, in cooperation with the U.S. Department of Transportation (USDOT) Research and Innovative Technology Administration (RITA) has established the Transportation Research and Analysis Computing Center (TRACC), a state-of-the-art modeling, simulation, and high-performance computing center located at the DuPage National Technology Park in West Chicago, Illinois. TRACC uses computational fluid dynamics (CFD) to improve analysis of the effects of wind and water forces on bridges and other hydraulic structures. TRACC uses commercial software, such as STAR-CD or STAR-CCM+ on its massively parallel computer to create computer models of flowing fluids to describe and predict fluid response, such as the flow of air around a moving vehicle or the flow of water and sediment in a river. Outreach is an important component of TRACC's mission, and thus this case study describes the use of videoconferencing to deliver one of TRACC's training programs to several remote sites.

Why Videoconferencing Was Chosen

The need to train researchers in the use of TRACC's massively parallel computer to create and run simulations of computational fluid dynamics models requires the delivery of high-quality video, audio and data to participants located at remote sites. Interaction between instructors and students to ask and answer questions is also needed. Since students are required to create and run simulations, there must be a way to share their computer desktop so that instructors can help debug problems. Videoconferencing based on the standard H.323 videoconferencing protocol met these needs.

The Execution

The first CFD training course was conducted at TRACC on April 27-29, 2009. CD-adapco, vendor of the STAR-CD software that TRACC uses for some of its CFD modeling, provided presentation materials and user manuals as a basis for the course. Additional training materials were developed by TRACC staff on the use of the TRACC cluster as well as tutorials related to hydraulics analysis. The course was offered using

H.323-based videoconferencing technology to create a virtual classroom with video and content sharing between three participating sites: TRACC, located in West Chicago, IL; Turner-Fairbank Highway Research Center, McLean, VA; and the University of Nebraska in Omaha, NE.

In addition, there were three sites where participants did not have access to videoconferencing equipment. Those sites were the Illinois Institute of Technology, the University of Illinois at Urbana-Champaign and the University of Iowa. Participants at these sites were able to watch and listen to the course using *Adobe Acrobat Connect* running on a standard web browser.

Large displays at the three main sites featured views of the classrooms and the technical course material with each site capable of displaying high-definition video. TRACC served as the presenter site where the instructors were located. TRACC and Turner-Fairbank both used *Polycom HDX 8004* high-definition codecs as end points. The University of Nebraska deployed a high-definition *LifeSize Room* system. The TRACC Polycom unit is capable of hosting three other remote end points in a multi-point conference and was used as the conference bridge for the event.

Argonne National Laboratory maintains a multi-user license for the *Adobe Acrobat Connect* service. Remote users can connect to a private virtual room hosted on an Adobe server using a common internet browser. The presentation site connects similarly, with only a browser plug-in required to share material from the presenter's computer with all other participants. The presenter's desktop is thus shared with remote sites using *Acrobat Connect* as well as the H.323 sites using the H.239 data sharing protocol supported by the videoconferencing units. Similarly, video and audio is shared with all participants.

The combination of H.323 videoconferencing and *Adobe Acrobat Connect* provided the means for group discussions of course material with all participants. A highlight of the course was a set of hands-on tutorial problems in which students at the H.323 sites used CAD and STAR-CCM+ software to, for example, build a bridge geometry, set up the physics for bridge flooding conditions, and run the CFD software to compute flood forces on the bridge under the guidance of instructors. When students ran into problems, they were able to transmit their screen content to everyone, allowing the instructors at TRACC to help. Participants at all sites were able to see and hear how problems were resolved. Course participants without H.323 videoconferencing technology were able to watch and listen using *Adobe Connect*. Feedback on the course was requested and received from the majority of participants.

Evaluation Comments

The instructors found that the virtual classroom created with the advanced videoconferencing technology was well received. The views of the other classrooms on the large displays were close to actually having the class at a single location. The technology allowed the instructors to monitor the attendees' understanding of the lecture and pick up the pace or wrap-up a session as required. This type of adjustment based on monitoring reactions of the class while speaking is not possible through most other internet training formats. One concern before the course was that not having a CFD expert at the remote sites would make problems encountered by students difficult to resolve. When CD-adapco runs CFD courses, there are usually two instructors, and while one leads everyone through a tutorial with students working on their own computers, the other instructor moves around the room helping people who get stuck. When students at remote sites run into problems during tutorials, the problems were resolved by using the content sharing technology, which had the added benefit of allowing everyone to see how problems are resolved in several different instances.

The biggest technical problem in preparing for the course was installing trial licenses for the CFD software on students's computers. This primarily was found to be a license server complexity unrelated to the videoconference. One student at TFHRC was actually talked through the license procedure by using the videoconferencing link, benefiting from a concurrent performance test. Options for streamlining the licensing process are being evaluated for the next course.

All responding participants felt the virtual classroom worked well. Most would like to participate in additional distributed CFD and related courses. All felt that the tutorials played a very important role in their learning experience. Working through several problems on a computer with instructor guidance proved to provide valuable hands-on experience.

A major advantage of videoconferencing for CFD training appears to be that a class can be composed of several small groups of participants at different locations. This is particularly advantageous when participants cannot afford to travel to a course location or when instructors cannot justify travel to provide training to smaller groups.

The Barriers

The only barrier noted was that not all sites had access to H.323 videoconferencing end points. Although attendees were able to successfully participate using *Adobe Connect*, they did not enjoy the same high level of experience (resolution of displays and interactivity) that the H.323 sites were able to achieve.

The *Polycom HDX 8004* codec used in this instance has a maximum capacity to bridge four end points. Larger numbers of remote H.323 sites would require an alternate bridge or Multipoint Control Unit (MCU).

The Enablers

Each videoconferencing site had broadband connectivity with Internet2 providing the interconnecting backbone. Each site was able to connect at 1920 kbps thus providing good video quality. Each site had a modern codec (either *Polycom HDX 8004* or *LifeSize Room* systems) that support high quality connectivity and H.239 data sharing.

The three sites without H.323 equipment were able to take advantage of the interoperability between H.323 videoconferencing and *Adobe Acrobat Connect* that TRACC provided.

It should also be mentioned that an important aspect to a good videoconference is testing the facilities well before the scheduled event. All sites were ready and eager to participate in pre-event qualification tests.

Advice for New Users

Videoconferencing encourages collaboration and sharing of information between participants in all types of distributed events. Good technical support is essential for a successful event, by providing the appropriate resources for the intended participants and content and by establishing reliable performance at all sites.

It is best when speakers are briefed in advance regarding the nature of videoconferencing, the use of specific microphones and camera presence, as well as what to expect. Discussions need to be clearly heard by all participants to be effective and the information presented should be shared with all remote sites.

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